(12)

EUROPEAN PATENT APPLICATION

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(54) Variable speed image panning.

(57) A display apparatus is described having the capability to pan a viewport image across a world-plane image. The viewport image has defined boundaries and exhibits a cursor whose position is movable by a user operated mouse or keyboard controls. The invention comprises a method for providing a variable-rate pan action of the viewport image which includes panning the viewport image at a preset rate in the direction of a first viewport boundary, if the cursor has been moved to the first boundary. The viewport image is panned at a proportionally faster rate in the direction of the first viewport boundary, as the cursor is moved further beyond the first viewport boundary thus enabling a variable speed pan under user control.
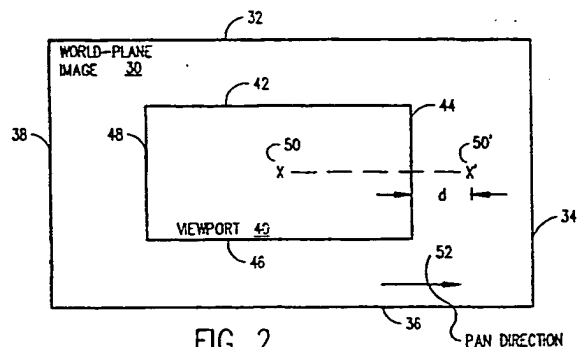
FIG. 2

EP 0 404 373 A1

VARIABLE SPEED IMAGE PANNING

This invention relates to variable speed image panning directed to the control of movement of an image on a display terminal at variable rates as by cursor control.

In graphics display terminals, it is known to provide a plurality of memories for various display fields. One such memory is termed viewport memory and contains the storage necessary to hold a pixel image for one "screen" of the display. Another such memory is termed the "world-plane" memory and contains sufficient storage for all pixels in a complete graphics image. Ordinarily, the world-plane image is considerably larger than the image displayed through the viewport memory, with the viewport only showing a portion of the world-plane. Under user control of a keyboard or other instrumentality, the viewport may be shifted from place to place within the world-plane to display images contained in the world-plane.

In the United States Patent 4,720,703 to Schnarel, Jr. et al, an apparatus and method for panning a viewport image across a world-plane image is disclosed. Schnarel et al employ a cursor to enable the panning of the viewport relative to the world-plane image. As long as the cursor is within the viewport, it is employed in the standard manner. When, however, the cursor is moved outside the viewport, the viewport is panned to include the cursor. By "panning" is meant moving the viewport in a measured manner to cause it to scan from one location to another with the cursor just being brought within the viewport before the panning ceases.

The present invention provides, display apparatus able to pan a viewport image across a world-plane image, the viewport image having defined limits and exhibiting a cursor whose position is movable by user operated means, wherein the viewport image is panned at a preset rate in the direction of a viewport limit if the cursor has been moved towards but is still within that limit but is panned at a faster rate in that direction if the cursor has been moved beyond that limit.

Such apparatus is appropriate to present-day graphics systems, in which Zoom features are included which enable the "blow-up" of discrete areas of the world-plane image. When in the Zoom mode, the panning of the viewport across a world-plane image may consume considerable tim is to be noted, in addition, that even in non-Zoom displays, it is considered to be advantageous to be able rapidly pan the viewport for rapid examination of various parts of the world-plane image, while also providing slower pan rates for detailed examination of the image. Thus, the viewport should be made "pannable" at different rates of speed, depending upon the user's desire.

As disclosed hereinafter, in one such display apparatus having the capability to pan a viewport image across a world-plane image, the viewport image has defined boundaries and exhibits a cursor whose position is movable by a user operated mouse or keyboard controls. The arrangement provides a variable-rate pan action of the viewport image which includes panning the viewport image at a preset rate in the direction of a first viewport boundary, if the cursor has been moved to the first boundary. The viewport image is panned at a proportionally faster rate in the direction of the first viewport boundary, as the cursor is moved further beyond the first viewport boundary thus enabling a variable speed, user controlled, pan.

In this way, it is possible to provide for panning a viewport at variable speeds across a world-plane image even where a single cursor control device also controls the panning action.

Since, as disclosed, panning rate control can be simply implemented by table look-up, it is economically possible to enable user-friendly operation of the display function.

The present invention equally provides, in a display which includes a cursor and is adapted to pan a displayed image screen, a method comprising

storing a world-plane image;
selecting a portion of the world-plane image as a display screen image;
displaying the display screen image;
determining if the cursor has been moved past a limit of the display screen image into an undisplayed portion of the world-plane image;
determining the distance the cursor extends past the limit; and
panning the display screen image to display an undisplayed portion of the world-plane image. the panning occurring at a rate which increases as the determined distance of the cursor past the limit increases.

The present invention will be described further by way of example with reference to an embodiment thereof as illustrated in the accompanying drawings, in which

Fig. 1 is a high level block diagram of a display terminal;

Fig. 2 is a schematic showing of a world-plane image on which a viewport has been superimposed, indicating the relationship therebetween;

Fig. 3 is a table showing various pan rates which are dependent upon the distance the user has moved the cursor outside of the viewport's

limits; and

Fig. 4 is a high level flow diagram illustrating the operation involved;

In Fig. 1, arithmetic logic unit (ALU) 10 is connected to a bus structure 12 that provides the major communication links between various sub-components of a display terminal. ALU 10 also contains within it, a sub-area (e.g. the area schematically shown at 14) which includes subroutine that enables the pan action to occur. A display 16 is also connected to bus 12 and contains (not shown) a cathode-ray tube or other display instrumentality for providing graphics and alphanumeric images. Display 16 also, in the known manner, indicates a cursor on its face, which cursor is movable through the action of a mouse 18 or other keyboard controls (not shown).

Ordinarily, ALU 10 will also have associated therewith both and disk memories which provide the storage instrumentalities for the system. In this case, those memories have been omitted from Fig. 1, but portions of the are indicated as viewport memory 20 and world-plane memory 22. Viewport memory 20 contains sufficient storage to define each pixel contained within a screen to be shown on display 16. World-plane memory 22 will generally contain an image which can also be shown on display 16, but which is best shown in discrete portions in a magnified manner. For instance, world-plane memory 22 can contain an integrated circuit layout map, with viewport memory 20 being used to store a pixel image of a portion of the world-plane for magnified viewing. Viewport memory 20 and world-plane memory 22 generally will form portions of the random access memory in the display terminal.

Referring now to Fig. 2, a world-plane image 30 is shown having its outer boundaries defined by limits 32, 34, 36 and 38. Viewport 40 falls within world-plane image 30 and is defined by viewport limits 42, 44, 46 and 48. Typically, world-plane image 30 may be comprised of 1024 x 1024 pixels or larger, whereas the viewport may comprise 640 pixels by 480 pixels in the horizontal and vertical directions, respectively. If a "Zoom" feature is employed by the display terminal, the pixels shown in viewport 40 will generally not correspond to the pixels of world-plane image 30 but, in fact, will be considerably larger in size than the pixels used in world-plane image 30. Thus, the actual size of the image viewed in viewport 40 may be only comprise a very small portion of world-plane image 30.

A cursor 50 is present in both viewport 40 and world-plane image 30 at exactly identical positions within the images. The position of cursor 50 is controllable in the known manner, by mouse 18 or by direction arrow keys on the keyboard of display 16. By moving mouse 18 in the direction of

viewport limit 44, cursor 50 is caused to move toward the right edge of the screen of display 16. When, as will be discussed below, cursor 50 arrives at limit 44, the viewport image 40 begins to pan to the right in the direction shown by arrow 52. If the user continues to move mouse 18 to the right, causing cursor 50 to move further outside viewport 40 (e.g. to point shown by cursor 50′) then the system recognises that fact and causes viewport 40 to pan at a faster rate than it would pan if the user just maintained cursor 50 at limit 44. Thus, while the user is unable to actually see cursor 50 move off of the screen by continuing to move mouse 18 in the direction of arrow 52, the rate of pan can be increased accordingly. It should be noted that cursor 50′ is to the right of limit 44 by a distance "d".

The distance d is repetitively "measured" and a table is then accessed to determine the pan rate associated therewith.

The pan operation occurs within the system of Fig. 1 by causing columns or rows of pixels to be added to the viewport limit in the direction of the pan, and for columns or rows of pixels (or the case may be) to be subtracted from the opposite image limit. In specific, if viewport 40 is being panned in the direction of arrow 52 in Fig. 2, then columns of pixels are added along limit 44 from world plane image memory 22. Similarly, a like number of columns are removed from the area adjacent limit 48 and the entire image is shifted so that it lies within the viewport's limits. The rate of addition of pixel columns and the number of pixel columns added is as shown in Fig. 3.

Fig. 3 illustrates a pan rate table which is stored within "pan" area 14 of ALU 10. The left-most column of the table indicates the d is d of cursor 50′ outside of a limit of viewport 40. If distance d is equal to 0, then it is known that cursor 50 is coincident with one of limits 42, 44, 46 and 48. In that case, the middle column defines the pan rate in pels (pixel's or picture elements) per second to be applied to the pan operation. The right most column indicates the amount of movement of viewport 40 per pan action, as measured in pels. For instance, if the distance d is measured at 5 pels, then the pan rate is indicated as 2 pels per second, with each pan movement being 5 pels. Thus, each time the image moves, it is moved 5 pels but at a rate of 2 pels per second, so that every ten seconds there have been two 5 pel movements of the image during that 10 second interval. The pan rate table of Fig.3 is merely exemplary as to the indicated values and does not come into action until it is determined that the position of cursor 50 is coincident with a limit of viewport 40.

Referring now to Fig. 4, the operation of the

variable speed pan will be described. Initially, the viewport's limits are defined within world-plane image 30 and the initial position of cursor 50 is recorded (boxes 60 and 62). Then, on a repetitive basis, the position of cursor 50 is tested (box 64). If it is found that cursor 50 has been moved (decision box 65), then the new cursor position is added to the initial cursor position (box 66), and a determination made as to whether the cursor is still within the viewport (decision box 68). If the cursor is found to still be within the viewport, then the cursor is moved as commanded (box 70). Of course, if no cursor move is found in decision box 65, the process merely recycles and the cursor position is again tested.

If it is found that the cursor is not within the viewport, it is then determined whether the cursor touches a viewport limit (decision box 72). If the answer is yes, then the intersecting limit is determined (box 74). If the answer is no, then the closest limit is determined (box 76) and the difference "d" is found between the new cursor position and the found limit (box 78). That distance d than enables access to the table of Fig. 3. Also, once the intersecting limit is found in box 74, the direction of pan is known (in the direction of the intersecting limit).

If the cursor is found to be coincident with a viewport limit, the pan rate and amount may be determined from the zero line of the left-most column of Fig. 3. If a distance d is found in box 78, that distance is used to address the pan rate table of Fig. 3 to find both the pan rate and the amount of movement per pan move. Those determinations are made in box 80, but before the pan action can be implemented, it must be determined whether the viewport limit is coincident with a world-plane limit. This is determined in decision box 82. If the answer is yes, no further pan is enabled in that direction, and the pan action is terminated (box 84). On the other hand, if a world plane limit has not been reached by a viewport limit, the viewport is panned by the amount and rate found from Fig. 3 (box 86).

At this stage, the keyboard output is interrogated to determine if a keystroke has commanded a cursor move (decision box 88). If yes, the routine recycles and again tests the cursor's position (box 64) etc. If no, the system interrogates whether a connected mouse movement input has been sensed. If none is sensed, then the viewport continues to pan at the same rate until it "hits" a world plane image boundary (boxes 82 and 86). If however, a mouse move is detected, the routine recycles to again test the cursor position (box 64) etc.

It can thus be seen that if the user continues to move the mouse in the direction outside and away from a viewport limit, that the viewport will continue to pan at an ever increasing rate until it reaches a world-plane image limit. Obviously, there is a maximum pan rate which will not be exceeded, no matter how fast the user causes the mouse to move in the direction of the world-plane image limit.

Claims

1. Display apparatus able to pan a viewport image across a world-plane image, the viewport image having defined limits and exhibiting a cursor whose position is movable by user operated means, wherein the viewport image is panned at a preset rate in the direction of a viewport limit if the cursor has been moved towards but is still within that limit but is panned at a faster rate in that direction if the cursor has been moved beyond that limit.

2. Apparatus as claimed in claim 1, including means for determining if the cursor has been moved beyond a viewport limit and the distance the cursor has been moved beyond the viewport limit and means for panning the viewport in the direction of the limit at a rate which varies with the determined distance of the cursor beyond the viewport limit.

3. Apparatus as claimed in claim 2, wherein the panning of the viewport is automatically terminated when a limit is reached of the world-plane image.

4. Apparatus as claimed in any preceding claim, wherein user cursor control is keystrokes at a plurality of keys on a keyboard.

5. Apparatus as claimed in any preceding claim, wherein user cursor control is via a mouse and the preset panning rate within the viewport limits is a direct function of the speed of movement of the mouse by the user.

6. In a display which includes a cursor and is adapted to pan a displayed image screen, a method comprising
storing a world-plane image;
selecting a portion of the world-plane image as a display screen image;
displaying the display screen image;
determining if the cursor has been moved past a limit of the display screen image into an undisplayed portion of the world-plane image;
determining the distance the cursor extends past the limit; and
panning the display screen image to display an undisplayed of the world-plane image, the panning occurring at a rate which increases as the determined distance of the cursor past the limit increases.

7. A method as claimed in Claim 6, further

comprising the step of terminating the pan action when a limit of the display screen image positionally coincides with a limit of the world-plane image.

8 A method as claimed in claim 7, wherein a mouse is employed to control the cursor, the method further comprising continuing the pan of the display image screen at a rate determined by mouse movement of the cursor, until the mouse again moves the cursor to establish a new movement rate.

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30

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40

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50

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VIEWPORT IMAGE MEMORY 20

WORLD-PLANE IMAGE MEMORY 22

ALU 10

PAN 14

12

DISPLAY 16

MOUSE 18

FIG. 1

WORLD-PLANE IMAGE 30 32

42

44

38

48

50

X

50'

X'

d

VIEWPORT 40

46

34

52

36

PAN DIRECTION
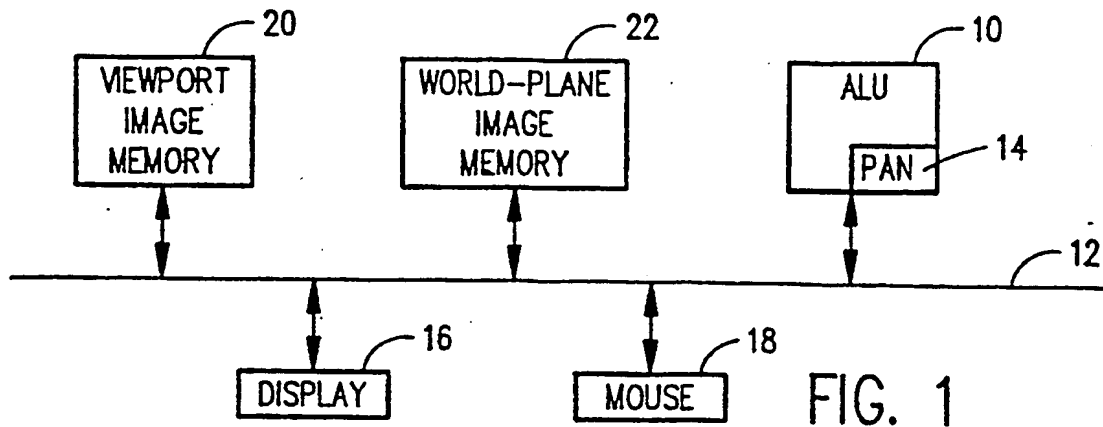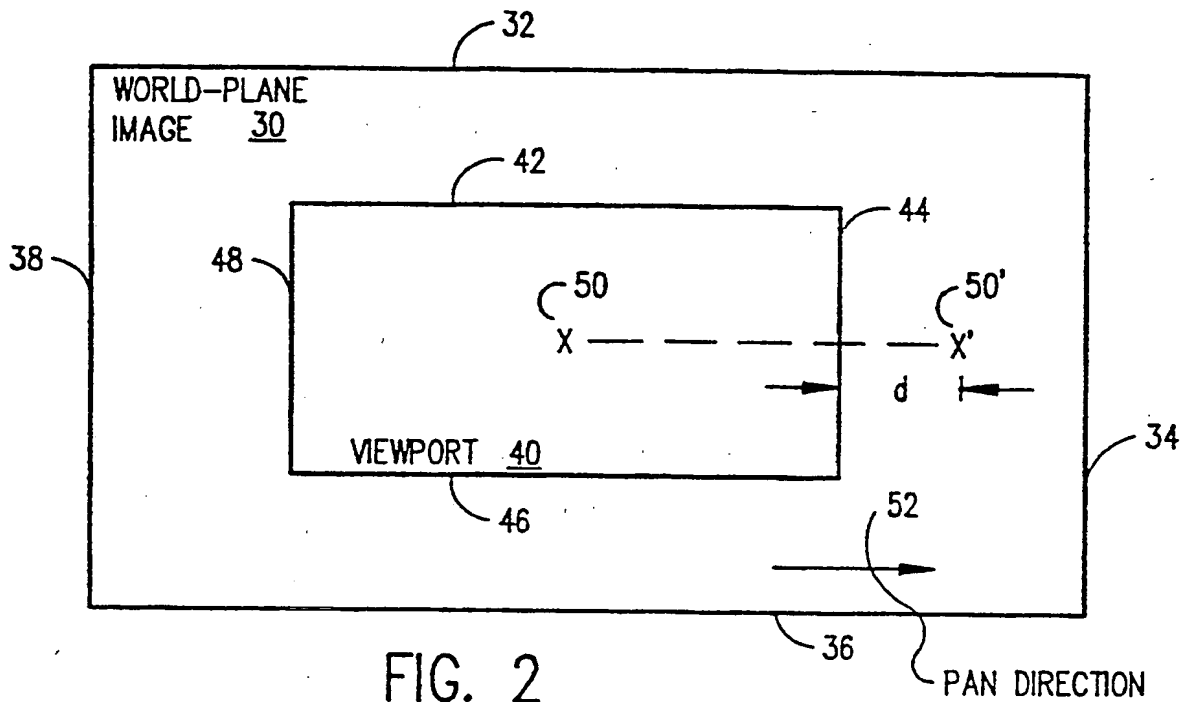
FIG. 2

PAN RATE TABLE

DIST & (PELS)	PAN RATE PELS/SEC	MOVEMENT PER MAN MOVE (PELS)
0	1	5
5	2	5
10	3	10
20	4	10
.	.	.
.	.	.
.	.	.

FIG. 3

```
┌─────────────────────────────┐
│   DEFINE VIEWPORT LIMITS    │──── 60
└─────────────────────────────┘
              │
              ▼
┌─────────────────────────────┐
│   RECORD INITIAL CURSOR POS. │──── 62
└─────────────────────────────┘
              │
              ▼
         ╱─────────╲           65
   NO   ╱  CURSOR   ╲
◄──────╱   MOVE?     ╲
        ╲           ╱                        ┌──────────────┐
         ╲─────────╱              70 ────────│ MOVE CURSOR  │
              │ YES                          └──────────────┘
              ▼                                      ▲
┌─────────────────────────────┐                      │
│  ADD CURSOR POSITION TO      │──── 66              │
│  INITIAL CURSOR POSITION     │                     │
└─────────────────────────────┘                     │
              │                                       │
              ▼                                       │
         ╱─────────╲   68                            │
        ╱  CURSOR   ╲        YES                      │
       ╱  WITHIN     ╲──────────────────────────────┘
        ╲ VIEWPORT?  ╱
         ╲─────────╱
              │ NO
              ▼
         ╱─────────╲   72
   NO  ╱  CURSOR    ╲    YES
◄─────╱ TOUCH VIEW-  ╲──────────────────┐
       ╲ PORT LIMIT? ╱                   │
        ╲─────────╱                       ▼
   │                              ┌──────────────────┐
   ▼                              │ FIND INTERSECTION│── 74
┌─────────────┐                   │      LIMIT       │
│FIND CLOSEST │── 76              └──────────────────┘
│   LIMIT     │                            │
└─────────────┘                            │
   │                                        │
   ▼                                        │
┌─────────────────────────────┐            │
│ FIND DISTANCE d BETWEEN      │── 78       │
│ CURSOR AND CLOSEST LIMIT     │            │
└─────────────────────────────┘            │
              │                             │
              ▼                             │
┌─────────────────────────────┐            │
│  FIND PAN RATE & AMOUNT      │── 80       │
│  FROM PAN TABLE              │            │
└─────────────────────────────┘            │
              │                             │
              ▼                             │
   ┌──────┐    ╱─────────╲   82             │
   │ NO   │◄──╱ VIEWPORT   ╲                │
   │ PAN  │── ╱ LIMIT=WORLD- ╲              │
   └──────┘ 84╲ PLANE LIMIT? ╱              │
              ╲─────────╱                   │
                   │                        │
                   ▼                        │
┌─────────────────────────────┐            │
│ PAN VIEWPORT BY FOUND RATE & AMOUNT │── 86│
└─────────────────────────────┘            │
              │                             │
              ▼                             │
   YES   ╱─────────╲   88    NO             │
◄───────╱ KEYBOARD  ╲────────────┐         │
         ╲  MOVE?   ╱             ▼         │
          ╲───────╱        ╱─────────╲  90  │
                      YES ╱  MOUSE    ╲  NO │
                     ◄───╱   MOVE?     ╲────┘
                          ╲───────────╱
```

FIG. 4
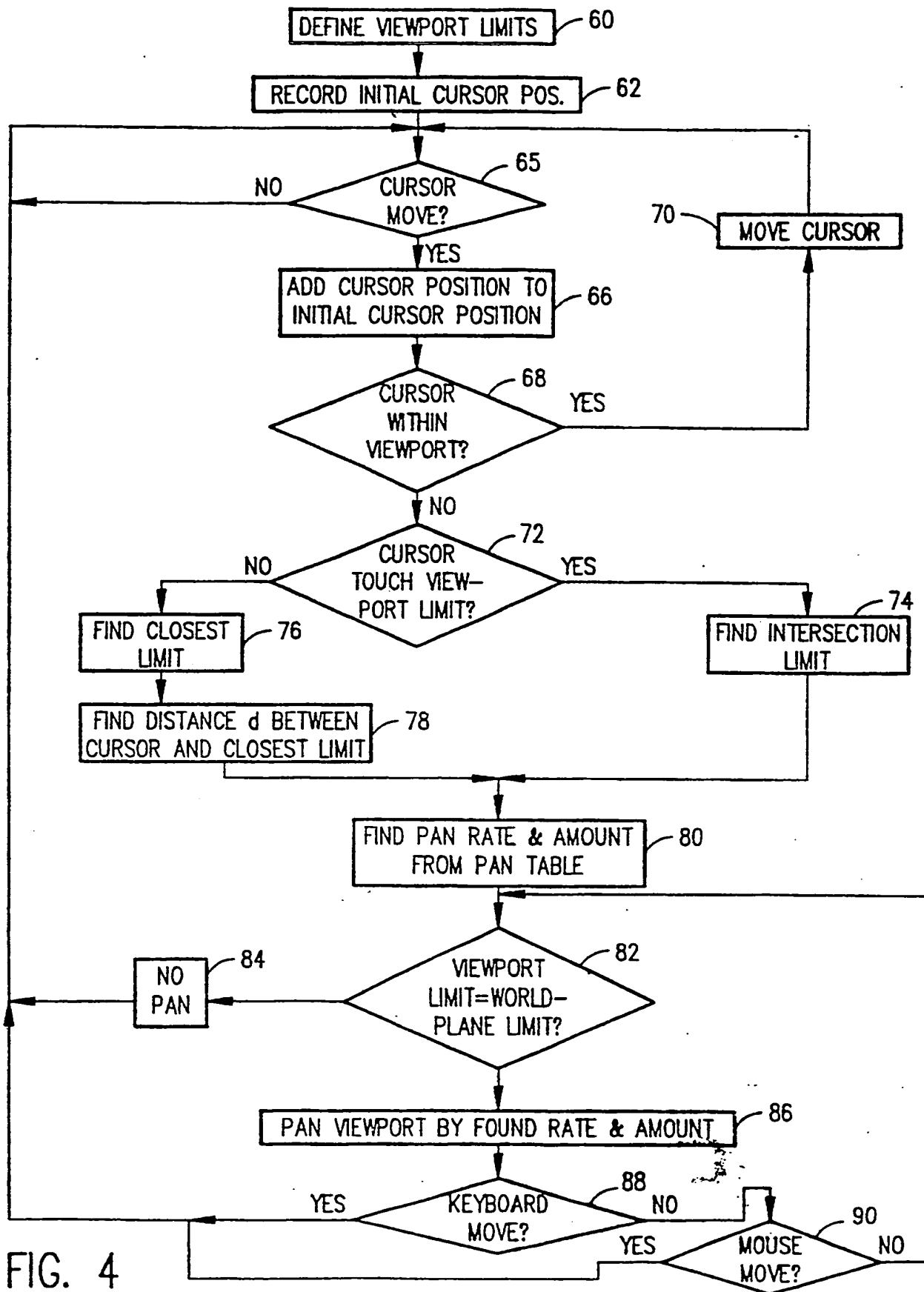
DOCUMENTS CONSIDERED TO BE RELEVANT			EP 90305976.4

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl⁵)
X	JAKOPIN "Steve", version 3.07, August 1988 COMPUTERTECHNIK KIECKBUSCH GMBH pages 11-6 * lines 1-10 *	1	G 09 G 5/34
A		2-8	
D,X	US - A - 4 720 703 (SCHNAREL) * Abstract *	1	
A		2-8	

	TECHNICAL FIELDS SEARCHED (Int Cl⁵)
	G 09 G 1/00 G 09 G 5/00

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
VIENNA	27-09-1990	KUNZE